DEVELOPING AN ENRICHED PROGRAM
FOR
HIGH SCHOOL SCIENCE THROUGH COMMUNITY RESOURCES

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DEVELOPING AN ENRICHED PROGRAM FOR HIGH SCHOOL SCIENCE THROUGH COMMUNITY RESOURCES

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Date

The undersigned members of the reading committee of Earl C. Foster have examined his project, "Developing An Enriched Program for High School Science Through Community Resources", and recommend its acceptance.

Representative of the
Graduate Committee

Date of submission to the
Chairman of the Graduate
Committee

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CHAPTER I

THE PROBLEM

It is the purpose of this study to find those community resources that can be used to excellent advantage in the teaching of high school science classes.

Specific Problem

> "In every community there are at least a few things or processes which may be studied to advantage in connection with one or more subjects taught. The teacher or course of study maker should be on the alert to discover as many of these as may constitute effective educational stimuli - particularly those which supplement, illustrate, verify, or increase interest in instruction in the classroom."[1]

Definition of Terms

Community resources are considered as a textbook, just another educational tool.

High school is considered to be grades seven through twelve.

Chemistry, physics, biology, general science and all mathematics courses usually offered in the high school are the science courses to be discussed.

Enrichment is providing additional material, supple-

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[1] Harl R. Douglass, editor, The High School Curriculum, p. 158.

menting the content of the regular text, which will tend to make the course more interesting and more closely related to the child's environment.

Delimitations

Although this study is planned primarily for high schools in Hillsborough County, Florida, many aspects are applicable to science courses in any high school.

Discussion of the longer type field trips is largely beyond the scope of this paper, which is concerned with utilizing the resources of the immediate community. This will include trips to the local industries and the use of such community resources that can be readily brought into the classroom.

Basic Assumptions

An enriched science program can only be presented by an enriched science teacher, therefore, considerable time must be spent by the teacher in broadening his own experiences, in science, and in science teaching. In modern teaching the textbook, as sole source of subject content, is far from adequate.[2]

Basic Hypotheses

All persons concerned with the education of our

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2. John P. Wynne, Philosophies of Education, pp, 258, 259.

present generation might stop and consider just what materials can be profitably used in addition to the traditional paper, pencil and textbook. Enrichment through community resources is not only easily done but is very meaningful and practical.

It is desirable for any school to become an integral part of the community. This can be facilitated by using community resources in connection with other curriculum materials. For teachers to utilize to the fullest extent these community resources, they must become active members in the community rather than segments of it. The only limitations for benefit, utilizing community resources in the classroom, are the limitations of the teacher himself.

The Need for the Study

Quite naturally, when a class becomes engrossed in a home or community problem, the home or community should be looked to for its solution. In the chemistry class the study of fertilizers and phosphates might well take the class as a whole to visit the local fertilizer and phosphate company. The physics class could be enlightened about many complex electrical problems by a short visit to the electric company power plant. The school which deals realistically with computations involved in filling out banking forms will profitably talk about banking in terms of the policies at the local bank. The biology students studying various plants and animals cannot help but talk about the plants and animals common to their own community

and more distant places where their family travels have taken them. They will greatly profit by field studies, transposing the classroom to the outside. The commercial arithmetic class will look to the transportation centers for timetables and maps. The home wood pile and local sawmill can much better give a permanent picture of the strand of wood and board foot of lumber than the textbook and teacher. Through this type of study, utilizing community resources whenever practical, the different classes can then readily see the significance of these type problems.

In using community resources in this way the students are growing steadily in their acquaintance with the world about them. This acquaintance is being built in realistic terms by the things they see and the objects they handle. More than this, they are building good techniques for securing information about their community. These children who have learned to observe carefully and from whom and where to seek help on specific problems, know where to go in their locality to find the most authoritative answers to questions. These children also are more apt to become those citizens that are an asset to the community.

Incidence of the Problem

The question of using community resources as an aid in teaching was forcibly brought to the investigator's attention during the first year of teaching mathematics and chemistry at Turkey Creek High School, Hillsborough

County, Florida, in 1948. Both the standard textbooks that were being used were fairly well out of date. Rather than go along with just the outmoded text, various other materials were used to supplement and bring the content in keeping with the times.

In chemistry many new advances had been made since the book was published. Of more significance than this, though, were the various questions and interests of the students concerning chemicals, problems and applications about them in the school, home and community. No text could deal with all these items.

In mathematics the problem was similar in that the old text had few problems significant to the times and community of the students. What would the volume of a silo mean to the child of a vegetable farmer who had never seen one? New problems were used which came from the child, teacher and community.

Interest arose in using community resources for enriching science courses during an inconclusive and informal survey. During this time it was found that little use was being made of them.

Related Literature

Wynne[3] states that when pupils do not have an opportunity to secure considerable first hand experience, even

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[3] John P. Wynne, Philosophies of Education, pp. 251-256.

the most valuable second hand experience is meaningless and insignificant to them. Yet, if they have no opportunity to deal with considerable indirect experience, they are unable to perceive the wide meaning and implications of things directly experienced.[4] Many experiences can only be had vicariously; such as, the measurement of the distance to the sun, stars, and planets. Among other objections to the use of the textbook as the sole source of content and material Wynne says,

> The conditions to which the public, the teachers and the pupils should be responsible are continually changing. They should not have to wait for the incorporation of a new topic in a revised textbook before dealing with it, and they should not have to wait for new subject matter materials, already available in the immediate environment, to be incorporated in textbooks.[5]

School and Community[6], a valuable textbook in this field, discusses the basic philosophy of the community school. It also discusses practical problems in scheduling, transportation, finance, legal liability, and community coordination and teacher education. It presents a plan utilizing documentary materials, audio-visual aids, resource visitors, interviews, field trips, surveys, service projects, and work experiences to bring the school and community into a closer relationship.

Selected articles in the Mathematics Teacher are invaluable as a source of information for mathematics

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[4] William H. Burton, The Guidance of Learning Activities, pp. 74-81.
[5] John P. Wynne, Philosophies of Education, pp. 251-256.
[6] Edward G. Olson and others, School and Community.

enrichment.

Listed below are additional periodicals that, from time to time have articles dealing with individual science courses and different ideas on their enrichment.

1. Education
2. Education Digest
3. Educational Leadership
4. Nations Schools
5. Progressive Education
6. Review of Education Research
7. School and Community
8. School Life
9. School Science and Mathematics

Procedure in Collecting Data

Historical research and normative-survey research was used for the collection of data. A community study was also made for the determination of available enriching resources.

These community resources are only intended to be the means to an end. While gathering the data, this and the following were always borne in mind. In using the resources, no attempt is made to acquaint children step by step with different aspects of their community. They are meant to help with the solution of problems which involve understanding the community. Field trips, excursions, resource people, or community resources brought

into the school are not used at stated and regular intervals to help children learn all they can about a given community enterprise. They are drawn upon when they are the most effective means of helping learners to find what they need to know about certain definite aspects of a community activity which are involved in the problem they face.

Procedure in Treating Data

The second chapter deals with enriching the teacher.

The third chapter deals with the various types of resources available in any given community. These different kinds include excursions into the community, both of long and short duration. Long trips are only briefly considered and a few examples are cited. Short trips into the immediate vicinity are discussed, taking up such aspects as benefit, planning, limitations, precautions and legal responsibility.

The second major classification of community resources are those brought and used within the actual classroom. These include both resource materials and resource people.

The next several chapters deal with the enrichment of the individual science courses including mathematics, general science, biology, physics and chemistry. The last chapter will include the summary and the conclusions.

CHAPTER II

ENRICHING THE TEACHER

Almost a prerequisite for the successful utilization of community resources is that the teacher knows the community. This can be accomplished by a survey of the community. Caswell and Campbell[7] list the following items usually included in a community survey:

1. Types of homes in the community
2. Types of industries
3. Occupations of the parents
4. Community organizations
5. Natural resources
6. Public buildings
7. Community attitudes
8. Recreations
9. Items of unusual historic or scientific interest
10. Newspapers
11. Public records
12. Traditions and customs peculiar to the community

This survey means more than knowing the number of

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[7] Hollis L. Caswell and Doak S. Campbell, Curriculum Development, p. 337.

churches, the names of the prominent business men and businesses. The teacher should know their interests and activities. Since it is not always possible for the teacher to live in the immediate vicinity other means can be used to become more familiar with the immediate area the school serves. The teacher can obtain desired information by taking part in the community activities, conversations with the people and through the daily newspapers.

Although resources are not the same in all communities there are many available wherever one is. To best acquaint the teacher with the materials and devices which will be good instructional aids this survey is suggested, both through the local literature and the local community. It is granted that this will take some time on the part of the teacher. Partial recompense for this extra time spent by the teacher will be in satisfaction in having an insight when the class discussion leads into the direct problems of the life close to them. In Des Moines, Iowa, interested teachers and community leaders compiled a list of community resources available[8]. This was part of their valuable in-service education program. In Hillsborough County, Florida, this type of survey could well be part of the work during the pre- and post-school sessions.

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8. Harl R. Douglass and Hubert H. Mills, Teaching in High School, p. 374.

It is not uncommon for teachers to take short or extended enriching trips. The Washington, D. C., mathematics teachers recently visited the Bureau of Standards to learn about things which would enrich mathematics teaching[9]. They were taken into the vault where the present standards of measure are kept. At the Applied Mathematical Laboratory they learned of the work being done there; they saw the remarkable sundial, which is worth a trip there just to see and also the beginnings of the remarkable new electronic computing machine. The Bureau of Standards is just one of the many bureaus which are doing work which could be used in enriching the teaching of mathematics.

It is not suggested that teachers make trips especially for enrichment, but trips are made by teachers each summer and they could well afford to work in visits that would be helpful in teaching their subjects. Visits to National Museum in Washington, D. C.; American Museum of Natural History, New York, New York; Chicago Museum of Natural History, Chicago, Illinois; and Smithsonian Institution, Washington, D. C. are interesting to most people and should be particularly appealing to science teachers. These individual examples are not available to all but in any section of the country enriching experiences are to be had that are both interesting and worth-while.

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9. Veryl Schult, "Are We Giving Our Mathematics Students A Square Deal?", The Mathematics Teacher, XLII (March, 1949), pp. 143-148.

CHAPTER III

THE COMMUNITY HAS ENRICHING RESOURCES

Even though no two communities are the same they all have enriching materials that can be used to good advantage in the classroom. In many cases the same short excursions are indicated and the same materials are widely available. In other cases unique resources are made available to serve the children only by the resourcefulness of the teacher, or by the peculiarities of the region and community.

For the purpose of this discussion, the community resource type of educational materials and devices are divided into two subheads: (1) the excursions and (2) those materials brought into the classroom.

The Excursion

The excursion is a good way to get first hand experience. It is desirable for the student to see things in their natural setting and hence get the real perspective of the problem under consideration. The utilization of longer type excursions, those lasting more than one day, is limited. Obvious practical limitations limit the usefulness of these long excursions in the average situation. There are many problems envolved in these longer trips

that are not too easily solved in the normal public high school. The shorter type excursions and field trips, those lasting only a few hours and never longer than one school day, are a fine way to motivate the students and provide the positive interest so desirable for a good learning situation.

Extended Excursions

Trips lasting several days and covering as many as 3,000 miles, are occasionally made. Many classes and, sometimes, groups of classes have found it very worthwhile to make these trips of longer duration. On occasion, some groups have even gone to live and work in communities other than their own, learning much about different habits, customs, mores and even folklore.

Educational trips of three to five days duration have been reported in New York City[10]. An Oklahoma school's Travel Club, composed of twenty-six pupils ranging in age from eleven to eighteen, with four teachers traveled to New York and returned by school bus at a total cost of fourteen dollars per pupil[11]. The small high school in Gilson, Illinois, maintains an extensive program of extended trips. Each student may make twenty or more tours

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[10] Julie W. Neumann, "The Eighth Grade Discovers Long Island", Progressive Education, 10:342-344, October, 1933.

[11] J. C. Fitzgerald, "Rural School Sponsors Long Summer Program", Curriculum Journal, 12:213-215, May, 1941.

covering the state, as well as four regional trips averaging 3,000 miles each[12]. In Michigan high school the Junior Red Cross initiated an eight-day trip to Canada as part of a school program[13].

The scope of this paper is such as to limit discussion of these longer trips to these few cited references.

Short Excursions

Situations can be studied in remote places by comparing the situation to something in the immediate vicinity of the school. A class interested in the reports of an invention or discovery which has been very beneficial to mankind can turn to the industries of their own community to find what similar advances have been made. The chemistry class following the reports of scientific developments in the use of plastics for improved housing and home living will turn to the local community and its homes for the applications and to the school and public library for further information. A tenth grade concerned about national proposals to provide for the health of working groups investigates what is being done in their town. Disastrous fires getting national publicity arouse a positive interest

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12. Alvin B. Roberts, "The Nation, Our Campus", Educational Screen, 20:5-8, January, 1941.
13. Frances Strauss, "Traveling Abroad in America", Progressive Education, 24:164-167, March, 1947.

not only in fire prevention but in the current "chapter" on the chemistry of extinguishers and the question will arise what system is being used at the near-by citrus packing plant.

Planning the Trip

The teacher should make the trip prior to the actual excursion. Going over the path, or through the plant before one takes the children makes it possible for him to do several important things. He can discover what will be of particular interest to the children. The opportunity of gaining some technical understanding is offered. The hazards, if any, can be spotted and later discussed with the class prior to the trip. If a guide is to take the children through a plant, the teacher has the opportunity to explain to him the interests of the group and particularly, their limited understanding of technical terms. He can also estimate how much help, if any, he will need to handle the groups. Of course, knowing the amount of time required to make the trip is one of the benefits of the preview.

Planning that does not include participation by the students would be poor planning. They should help decide, first of all, that the trip is desirable. If the route lies in part along a highway, the question of how the group should walk, calls for intelligent planning on their part. It is interesting to note that the more they participate in de-

ciding such problems, the simpler are the discipline problems of the trip. The children should decide what equipment to take, who is responsible for the camera; whether reference books will be needed; are specimen jars necessary, etc. This opportunity for planning by children is in itself one of the most desirable features of the excursion.

If the selected place is some distance from the school, planning for transportation is envolved. This may require a chartered bus, school bus, parents' or student's cars, city buses and streetcars or even trains. It is important to make sure that private cars or buses are driven by licensed operators and that insurance is carried on the vehicle. The preview trips pay off here in arranging time schedules for the transportation. There is a possibility of a misunderstanding occuring in the event a parent is furnishing a car. This may be avoided if the parent is advised ahead of time in a polite manner that the teacher is responsible for the children at all times. Division of authority is never desirable.

As an aid to planning it would be very desirable for a file to be set up in the school office of these community trips. Pertinent data for each contemplated trip would be available in one glance. Suggested content for each trip would include:

1. Place
2. Location
3. Telephone

4. Person in charge
5. Time away from school
6. Experiences
7. Cautions

Legal Responsibility

Some teachers hesitate to take children away from the school because of the hazards that may be involved, and concern over their legal responsibility. Two legal principles are pertinent here. In the first place, the teacher is never the insurer of the safety of his youngsters. That is to say, he never does assume legal responsibility that Samuel will not break his glasses on the playground or in the classroom; or that Helen will not shut her fingers in the door. Secondly, teachers, like everyone else, are legally responsible for their own negligence. If he fails to provide any supervision for Samuel on the playground, or if he repeatedly fails to report the defective door stop, he is legally responsible to the children's parents.

The teacher who makes the preview trip, discusses hazards and desirable conduct on the excursion with the children and who uses reasonable care and judgment, need never worry about legal responsibilities.

Precautions

Care should be taken to make sure that the proposed trip is relevant. Too often dependance of the trip is based

upon the availability of resource, rather than by free choice. Excursions are sometimes taken merely because they are "fun" or seemed the thing to do. Many times the majority of the trips are taken by the same teacher. Upon looking through the literature no difficulty is experienced in finding advice on how to conduct the trip, the avoidance of traffic accidents, legal responsibilities, where to go, etc. Neglected, has been the use of data taken on the excursion, how to prepare the class for the new experience and classroom use of the results of the trip.

Care should be taken in the collection of data. Some trips result in the collection of meaningless data and materials. Too much material that may be incoherent and isolated factual material is brought into the classroom that can never be used. Where the gathering of materials for eventual classroom use is in itself educational, the class will profit immensely. The biology class that journeys to the field, stream, and seashore to get insects, algae and marine specimens; and sees these items in their natural habitat is one example of a worthwhile trip. The witnessing of a complicated process by the chemistry class could possibly lead only to bewilderment, unless the proper adequate background has been laid and is followed up later when back in the classroom the following day or days. Seeing machinery, equipment of pipelines are far different than the flow diagrams and schematic sketches indicate. Pipelines

of household size or in the sketches are far different than the huge, possibly insulated, pipelines found in the nearby industries, which may take on strange shapes and mammoth proportions. All this will add to the student's confusion unless he has it adequately explained and he is properly prepared to see what he will see.

Resources Brought to the Class

It is very desirable to supplement the content of the textbook with considerable other materials. One such type of supplementary material is that derived from the community. One important type is the materials and things; the other main type is resource people that may come into the classroom.

Resource Materials

Community resource materials come into the classroom more often than children go to the community. Teachers and children call upon parents who have traveled, for pictures, articles, or information typical of life in other countries; as well as, for firsthand descriptions. The children know of the rock and shell collection or the exhibit of butterflies owned by local naturalists. The teacher may ask parents and other community members to share their hobbies with them. Both groups are rewarded in this sharing. From the pamphlets and exhibits prepared by local agencies come other resources - a series of pictures or display

showing the steps in the development of a product, a number of bulletins from the neighboring experimental farm, government publications. The loan collection from the public library and the exhibit from the natural history museum are used often in this fashion.

Community at Large

One source of community resources is material put out by governmental, industrial and business organizations, some of which is expressly meant to be used in the classroom and is to be had either free or at a nominal cost. The "Educators' Index of Free Materials"[14] is a very good aid to the principal and teacher in locating free material for the classroom. Fowlkes[15], sums up the value of these resources in the outline which follows:

1. Improves the curriculum
    a. Keeps curriculum from becoming out of date
    b. Makes the subject matter more meaningful by keeping in constant contact with the development of social and industrial importance.
2. Improves the teachers' work
    a. Prepares teaching units
    b. Organizes an activity program

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[14] John Guy Fowlkes, "Educators Index of Free Materials", Educators' Progress Service, Randolph, Wisconsin, 1949.

[15] *Ibid*.

  - c. Organizes a good bulletin board program
  - d. Provides for individual differences

3. Improves pupils' work
  - a. Stimulate pupil interest
  - b. Gives pupils opportunity and means of doing things for themselves

Resource People

A survey by Public Schools of Glencoe, Illinois[16], revealed a wealth of resource people in the city of Glencoe. They found many people of interesting occupations and hobbies, people who had worthwhile collections and had enriched their lives through travel and had taken photographs while on these trips. Data taken on this survey was recorded, classified and filed for use of the teachers. This has made possible the use of material that otherwise would have been passed by as the non-existant. The fact that these people were found in Glencoe is indicative of the possibility of locating people in any community for use in enriching any course.

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16. Paul J. Misner, "Forgotten Men and Women", Progressive Education, 19:15-20, January 1942.

CHAPTER IV

MATHEMATICS

Mathematics is probably considered one of the more difficult subjects to enrich; yet if the textbook is coldly and logically covered and no supplementary materials used, considerable value of the high school mathematics is lost as in any textbook study.

Motivation

Motivation is a very necessary quality of experience. Enrichment will provide a positive interest but is not encouraged for the stimulation of interest alone. Better learning and the educational benefit derived by enriched teaching, seeing mathematics in the correct perspective and as a part of their life experiences is the desired goal. Fifty years or so ago the statement, "colleges require that you master this subject", was sufficient motivation in itself. Today, with compulsory education laws and with a higher percentage of children wanting the high school education, but with a smaller percentage of those getting through high school going to college, this has no appeal whatsoever; only one high school graduate out of five has any prospect of going to college. This

is substantiated by a current book of facts[17].

Precautions

Carnahan[18] gives three precautions to be observed in the enrichment of mathematics teaching.

1. Enrichment should be an integral part of all mathematics teaching, not a special feature added on as an afterthought, or substituted for other class procedures, or served as one serves a party refreshment.

2. Enrichment should not and need not be made to consume much class time, say an average of twenty minutes per week.

3. Enrichment is not a substitute for good methods as the term is commonly used. Enrichment can never successfully substitute for careful, meaningful development, for practice, for testing for class organization, or for teacher personality.

Resources as Enrichment

Bent[19] gives the following resources which can be called upon from the community for enriching mathematics:

1. Varied places in which may be seen geometric

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[17] The World Almanac and Book of Facts for 1949, p. 374.

[18] Walter H. Carnahan, "Enrichment of Mathematics Teaching", The Mathematics Teacher, 42 (January 1949), p. 14-18.

[19] Harl R. Douglas and others, The High School Curriculum, (New York: Ronald Press Company, 1947), p. 160.

designs

2. Various places on which may be based measurements and problems involving computation
3. Prices of goods in stores and in advertised prices
4. Installment buying and small loan figures

A few other community resources can be added to this list which would have a significant place in the mathematics course, vividly showing the application of the subject to daily living:

1. Bank forms of all types
2. Consumer bills
3. Telegraph blanks
4. Utility bills which give the rates
5. Transportation timetables
6. Highway maps
7. Newspapers
8. Telephone directory
9. Professional and business men
10. Income tax forms

To make this list longer and at the same time enrich one's teaching, one class assignment might be to have the children see how many examples of mathematics they could find in one day of living in the community. Suggested places for the students to look would be machines and instruments, art and decoration, advertising and propaganda, textiles and

floor coverings, maps, and as revealed in nature, in particular, geometric figures.

The comment has been made that schools should be a part not apart from the community. A questionnaire was sent to the mathematics teachers in Washington, D. C. in 1948, to find out how they were using community resources to enrich their teaching. It revealed many possibilities[20].

1. Many classes used community data from drives such as Community Chest and Red Cross, city budget, school data sent out by the statistics department and the current water, electricity, and gas rates, in problems and in graph making.

2. Some classes used blue prints of their school in their study of measurement and scale drawing.

3. Many teachers used material furnished by insurance agents whose children were in their classes or from such organizations as the Institute of Life Insurance, 60 East 42nd Street, New York City, New York. This institute, or its representative in other cities, lends without cost, except for postage, the film, "Search for Security", which portrays some of the history of insurance. This same organization supplies, free of charge, copies of the "comic book", "The Man Who Runs Interference", which portray's some of the purposes and values of life

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[20] Veryl Schult, "Are We Giving Our Mathematics Students A Square Deal?", The Mathematics Teacher, 42 (March 1949) pp. 143-148.

insurance.

4. Bankers have come in to discuss the service that banks perform.

5. Owners of small businesses came in and talked about problems of business such as profit and loss, taxes in business, pay roll deductions.

6. A city engineer showed the use of a transit to a trigonometry class and took the class on a survey trip.

7. A state inspector for weights and measures discussed measurement.

8. A social security representative talked to a consumer mathematics class.

Some of the values of using these community resources are:

1. Contact with the working world.

2. Students learn that there are many sources of information besides that of the teacher.

3. There are fewer questions, such as, "Why do we have to study this stuff?".

The Educational Section of the School Savings Division of the U. S. Treasury keeps a supply of good materials coming to the schools. Several of these, which are available in quantities for mathematics classes are:

"Teaching Mathematics Through School Savings"
"Budgeting for Security"

"Lessons in Arithmetic Through School Savings"

Catalogs can be secured from mail-order houses and orders made out to give practice in considering quantity, quality, size, mailing charges, and methods of payment. Most homes have a gas or electric meter or both. Keeping a record of the home consumption and computation of the bill using the rate tables will be a good experience. All these are mathematical uses which will be common in every day life. Even a good percentage of adults do not understand these.

Enrichment of mathematics by means of puzzle and challenge problems is an old and widespread practice. The time spent in such work in the actual classroom need be only a few minutes a week, but for some students this would provide much joy and perhaps hours of recreation in his leisure time. Many a child would enjoy challenging his parents and older friends with such problems as:

> A frog is in a well which is twenty feet deep. He jumps upward three feet each day and slips back two feet every night. How long will it take him to get out?

Or:

> A man died and left seventeen camels to his three sons. The eldest was to inherit one-half of them, the second was to have one-third and the youngest was to have one-ninth. How can the division be made?

One good puzzle with a direct algebra relation would be:

> There are 1,872 tacks, nails, and screws mixed together in a box. If there are three times as many

> tacks as nails, and three times as many nails as screws, how many of each are there in the box?

The students themselves should be encouraged to bring problems of this type to class. A small task for one or two of the rapid learners would be to keep a class notebook of these puzzles. He or she would find such a duty very pleasant.

The teacher who puts into effect a program of enrichment of mathematics teaching may have the experience of finding that pupils become fascinated by the enrichment experiences and fail to transfer this interest to the mastery of the principles and techniques of arithmetic, algebra or geometry. It is by no means the easiest phase of enriched mathematics teaching to make it function as a true educational experience, but this must be done or the whole program will fall into disfavor and we shall lose many of its very real benefits.

Commercial Arithmetic

Commercial arithmetic lends itself very readily to the full adaptation and absorption of many community resources. Almost every phase of the course offers practical problems that can be asked and answered with the aid of material direct from the community. This is life itself and the application of tangible evidence such that the student readily and eagerly accepts the knowledge; possibly with even one or a few beginning to be grateful. The mathematics is now meaningful,

purposeful, and interesting.

Listed below are some of the suggested community resources available for the various topics discussed in commercial arithmetic.

1. Bank - for the treatment of the discussion of this subject and the problems envolved, it is very advantageous to use the actual forms obtainable from the bank. These would include checks and check-stubs, deposit slips, and bank statements.

2. Timetables - included would be the timetables for travel by rail, bus, sea and air.

3. Rate schedules - parcel-post and railway express.

4. Income tax forms - national and state, if applicable.

5. Sales tickets - should obtain these from several sources.

6. Personal finance - pupils would be encouraged to bring in their own problems as if they were buying a washing machine on the installment plan, borrowing money or buying a home with a down payment. The figures for such problems could be obtained from local companies or from the daily paper. Such problems would be more interesting, meaningful, and hence much more profitable.

Many more examples could easily be cited. The actual opportunities available in this particular subject are too numerous to enumerate fully and the only limitations for

benefit in utilizing community resources in the classroom, are the limitations of the teacher, himself.

Arithmetic

Most schools devote the seventh and eighth grades to a thorough study of percentage and to ratio and proportion. The advanced application of percentage, those that involve business customs of a higher class, are commonly postponed till the eighth grade when the pupil has a greater interest in commercial affairs.

Ratio problems derived from the community will be more meaningful and more actual learning will take place. Listed below are some sample problems for the country students.

1. If a shipment of 5100# of cattle, live weight, sold for $225.42, what would 3500# of cattle sell for at the same rate?

2. If a farmer paid $85 for 3T 1500# of cottonseed meal for fodder, how much would he have to pay for 5000#?

3. If in 225# of milk there are 8.1# of butterfat, how many pounds of milk will be required to produce 27#?

4. A farmer had 26 A. planted in potatoes. The crop from 7 A. amounted to 1260 bu. At the same rate, how many bushels did he receive from the whole field?

5. To irrigate a farm at the rate of 1/5 in. in depth every day requires the flow of 210 gallons an hour. What flow would be necessary to irrigate it at the rate of 0.3 inches

a day?

The work in the eighth year is in the line of business applications. The students should now begin to feel that the world of business and of life is opening before them. It should therefore be the duty of the teacher to apply the mathematics to the genuine problems of life, particularly with reference to the common occupations of the people.

In banking, for example, we should not seek to train accountants, bookkeepers or cashiers, but we should seek to give a fair idea of the duties of these men in the ordinary bank. One can get no better an impression than actually seeing the bank at work. Most banks would welcome a visit which need last no longer than twenty to thirty minutes and would be happy to explain the simpler operations involved in depositing money and drawing checks. A banker's words would leave the child with a more lasting and vivid picture of the problems involved. The interest of the children is now aroused so that maximum benefit will result as the class fills out the following day the actual banking forms obtained from the visited bank.

Insurance has become so technical that all the schools can hope to do at this grade level is to give a general conception of the work of the various kinds of companies, confining the problems to the simplest practical cases that the people need to know about. No attempt should be made to

enter upon the technicalities of agency work, nor do more than explain briefly some of the common types of policies.

A very good introduction to the insurance subject and problems could be very suitably made by a community insurance agent. He could cover the importance of and place for insurance in the lives of most people. In using figures on the blackboard he would introduce and arouse the interests of the students in many mathematical problems. He would explain the purposes of the different types of insurance policies. The subject of taxes like others of practical life, could be treated from the standpoint of local conditions as far as possible.

CHAPTER V

GENERAL SCIENCE

One of the major needs for the ninth grade general science course is a source or sources of enrichment that will make the course very practical. An enrichment using community resources will bring the boys and girls in close touch with the events that are actually happening about them. A general science course may too easily become centered about the textbook if care is not exercised. The subjects covered are apt to be those personally preferred by the teacher with an occasional demonstrated experiment. The average school has not the facilities to offer a laboratory course in connection with the theory. Enrichment is desirable; enrichment that will make the subject more realistic and through aroused interest will motivate the student to a better understanding of the principle involved.

A Recent Survey

The list below is the product of teachers[21], representing thirty high schools of varying sizes. These are the community resources they used in the teaching of general

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[21] Members of a graduate course in high school methods at the University of Colorado, Summer 1947 (H. H. Mills, instructor.)

science.

1. Health department and health laboratory
2. Tuberculosis clinic
3. Hospitals

   These three above provide literature, charts and diagrams and speakers upon request to aid in teaching Health Education unit.
4. Fire department
5. Water department

   These departments provide conducted tours and speakers on fire prevention.
6. Sewage disposal plant

   At this plant it is possible to become acquainted with the precautions against spread of desease by water, air and insects.
7. Museum

   Some museums conduct field trips (flowers, birds, rocks) and have extensive libraries of visual aids.
8. Parks

   These are numerous and well supplied with a variety of plant and animal life indigenous to the region.
9. Coast guard station and weather bureau

   These have numerous weather measuring and forecasting devices; give practical value and motivation to related teaching by posting flags and permitting students to read instruments and

interpret readings.

10. Harbor

    It presents opportunity to observe interesting transportation relationships.

11. Airports

    These present possibilities of ground instruction in principles of buoyancy, stability, and unbalanced air pressure under more convincing instructors than teachers (pilots, navigators, etc., who frequent the air port); provide excellent practical motivation and vocational guidance.

12. County agricultural agent - speaker on all phases of conservation.

13. State university library of films

    These are available to the schools of the state.

14. Privately owned public utilities:
    a. Electric light and gas companies present in their demonstration hall films and experiments for the public. These are announced in advance so teachers can prepare their students.
    b. Telephone companies are a source of information on rates.
    c. Transportation lines provide transportation for trips.

15. Clubs
    a. Conservation
    b. Garden

c. Camera

The above three provide speakers, films, and exhibits on requests; conduct shows, displays to stimulate vocational and avocational interest.

d. Boy Scout

First Aid Corps provides speakers and demonstrations applicable to safety and health.

Listed below are a few of the many bulletins that are obtainable free from agencies as listed in the previously mentioned, "Educators' Index of Free Materials", and are good examples of supplementary materials:

1. "The Use and Care of the Microscope", includes principles of microscopy; 32 pages, Baush and Lomb Optical Company, Rochester, New York.

2. "The Storage Battery", its fundamentals, use and maintenance; 23 pages, illustrated; Electric Storage Battery Company, Allegany Avenue and 19th Street, Philadelphia 32, Pa.

3. "Adventures in Electricity No. 1", - comic book on the generation of electricity. Others on the use, distribution of electricity, also in medicine and railroading. General Electric Co., Schenectady, New York.

4. "Short Storiesof Science and Invention", a collection of many interesting short stories of scientific discoveries. General Motors Corp., Department of Public Relations, Detroit 2, Michigan.

5. "Story of Plants" and "Story of the Soil" on how

plants get their food. Swift & Company, Agricultural Research Department, Chicago 9, Illinois.

6. "Man's Heritage of the Skies", booklet on atmosphere, weather, climate, 16 pages. Westinghouse Electric Corporation, Pittsburg, Pennsylvania.

Charts and posters are also valuable additions in any classroom. These are used for added interest at the bulletin boards and for brightening up the general science room in general. Below are listed several such items that are also obtainable free from the companies to the science teacher.

1. "General Electric Photo News", General Electric Company, 1 River Road, Schenectady, New York.

2. "Westinghous Pictorial Bulletins", Westinghouse Electric and Manufacturing Co., Pittsburg, Pennsylvania.

The above two are bi-weekly posters that tell in picture and caption the various scientific and engineering activities of their respective research bureaus.

3. "Metric Chart", Bureau of Standards, miscellaneous publication #3 (30¢) c/o Superintendent of Documents, Government Printing Office, Washington, D. C.

4. "Laboratory Emergency Chart", free, Fischer Scientific Co., Chicago, Illinois.

5. "Cloud Chart", free, "Teachers' Materials", U. S. Weather Bureau, Washington, D. C.

Excursions

First hand experience is very valuable in promoting

quick, effective learning in many situations. An occasional short trip into the immediate community is often indicated by the students' questions, interests and topic under consideration. During a discussion on water, its purification and its different physical forms, a short trip to the city water plant and the local ice plant would be very desirable. A trip to the electric company's plant would interest most in the introduction to electricity. The study of crops and floral life would certainly mean a trip into the country or to the greenhouses and nurseries.

CHAPTER VI

BIOLOGY

The most popular science to students in Hillsborough County, Florida is biology. The numbers taking it far exceed the number taking either chemistry or physics and more than that most seem to enjoy the subject. Dealing with living things is usually more interesting to a growing child than inanimate objects or abstractions. So in keeping with this and with Webster's definition, "study of living things", the course should be made exactly that. These living things should rightly be those from the community itself and not limited to those plants and animals in the aquarium, which is discussed later.

Representatives of thirty high schools[22] gave the following list as community resources they used in teaching biology:

1. Wild flowers for collections
2. Insects for collections
3. Identification of trees
4. Leaves for collections
5. Dispersal of seeds by wind, animals and water

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[22] Members of a graduate course in high school methods at the University of Colorado, Summer 1947 (H. H. Mills, ins.)

6. Fish (identification, habitat, etc.)
7. Amphibians (frogs, salamanders)
8. Reptiles (snakes, horned toads, turtles and lizards)
9. Birds (identification, habitat, calls)

Living Resources

Snakes can easily be kept in the laboratory and in all localities, especially where poisonous snakes are found, the students should learn to identify the snakes. This should be accomplished by the students' displays of live snakes and not by hard-to-interpret pictures. In addition, probably many girls will partially overcome their extreme unrational fear of snakes. Frog eggs are easily found and with some care will develop in the biology laboratory. Even if only one egg would hatch and change from the tadpole into a frog the meaning of metamorphosis will have been grasped by the students. The live frog can be used to much better advantage than the pickled specimens. Cocoons are also easily found and brought into the laboratory. It is true that there is much more work in caring for the live specimens but the results obtained will in no doubt compensate for this.

Balanced Aquarium

No biology room is complete without a balanced aquarium. A cross section of the community pond is proposed, using only those materials, plants and animals that the students themselves bring in.

Even water direct from the pond is used because it is not only free from chlorine but also supplies the microscopic plant and animal life of the pond. Large glass demijohns are very convenient for the collection trip. Some of the pond water is retained outside the aquarium for use in smaller containers to study eggs and larvae. Plants suitable for aquaria can be obtained locally also to good advantage. Professional and hobby aquarists shun locally collected plants preferring "aquarium grown" material. The teacher uses native plants as a means of teaching the pond life of the region and for emphasis on natural conditions. Many of the "pond weeds" grow well in small aquaria.

The animal life should also be restricted to that which is obtained from the pond. A vast business has been built on tropical fish. Some of these may have value in the laboratory but a complete aquarium can be maintained from the commonest types of pond snails, insect eggs and larvae, a few amphibian eggs and tadpoles, or such other aquatic forms as are brought in from time to time by students or acquired on field trips. A word of caution is given to avoid overloading the aquarium. Teach conservation, and leave in the pond all that is not needed in the classroom. The aquarium is a constant source of interest for the students who will learn much merely from observation.

Plants

Plants are much easier to handle in the laboratory

than animals and hence this is more frequently done. In teaching the divisions of the plant kingdom the classroom will be adequately supplied from the local community by the students themselves, availing themselves of specimens from home, the school grounds and elsewhere in the community, even the greenhouses and nurseries. Many plants can easily be kept and cared for by the students.

Also to be studied alive are cultures of bacteria grown in the laboratory. As these are studied, more interest will be in evidence and more real learning taken place than if only a picture or a prepared specimen is used.

Field Trips

It is not proposed that the biology laboratory can house all the needed live specimens of plants and animals It is even possible that such an arrangement could fail to be an integral part of the course of study. In some cases these merely are used to create the correct atmosphere in the biology room and become ornaments and decorations. When properly used these specimens have a definite functional value as teaching materials. The use of these live materials should not end with those that have been brought in. Field trips should be taken so that additional live materials may be used and, just as important as this, is seeing them in their natural setting.

Various studies have been made as to the extent that field trips are used and to the extent they should be used. Tinkle[23] and Stevenson[24] found that only about fifty percent of the biology students questioned had been on field trips. The students that had been on the trips considered them to be most valuable, enjoyable and worthwhile portions of the class work. Washton[25] questioned 1200 pupils and found that over 90 per cent of these felt that they had missed valuable experiences by being denied the opportunity of having these outdoor classes. Schellhammer[26] experimentally demonstrated that the field trip was an effective and almost indispensable aid in creating a good learning situation.

The use of canned specimens should be kept to a minimum. Public museums are getting away from the impression that they are archives of the dead. In place of these dead exhibits are live ones in the aquaria and on the nature trails that have been set up. When this is not possible, habitat groups are made, reproducing the environments of various animals. Many museums regularly sponsor field trips

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[23] W. J. Tinkle, "Field Trips in Biological Courses", <u>School Science and Mathematics</u>, 33:947-950, 1933.

[24] E. N. Stevenson, "Questionnaire Results on the Value and extent of the Field Trip in General Biology", <u>Science Education</u>, 24:380-382, 1940.

[25] N. S. Washton, "Findings in the Teaching of Biology" <u>School Science and Mathematics</u>, 41:553-558, 1941.

[26] F. M. Schellhammer, "The Field Trip in Biology", <u>School Science and Mathematics</u>, 35:170-173, 1935.

and excursions for school children[27].

As some authors have pointed out, many field trips taken by biology classes do not meet with success. Success depends on many factors and a thorough study should be made in order that the biological excursion may serve to the fullest advantage. Dexter[28] lists many points along these lines of which the most important ones are listed below:

1. Familiarity with the region.

The instructor must know what the community contains and the different advantages of various localities.

2. Organization of the trip.

The trip must be carefully planned much the same as any excursion. This is covered in Chapter III. Wood[29] has written a good article in discussing the planning necessary to carry out an effective trip.

3. Objectives.

Each trip taken should have definite objectives. This will eliminate the taking of a trip merely for an outing or to be popular. It will also eliminate much aimless wandering.

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[27] Ralph W. Dexter, "Field Study - The Backbone of Biology and Conservation of Education", School Science and Mathematics, 43:509-516, July 1943.

[28] Ibid.

[29] Dora Wood, "Planned Field Trips - An Integral Part of Science Units", School Science and Mathematics, 41:28-35, 1941.

4. Proper Attitudes.

The development of proper attitudes is important in all courses or studies. Whether the students consider the trip really worthwhile or just a more pleasant way of passing the time depends on the instructor. Adams[30] in his report deals with the establishment of standards and attitudes.

5. Collections.

On field trips the main value is derived in seeing life and seeing it in its natural setting. If a specimen is needed it should be brought back to the classroom and properly taken care of. Only that material that will serve a future purpose should be collected, all else left as it is found.

Resource People

Occasionally the opportunity may present itself in getting a person outside of the school to come in and give a short talk to the students on some form of wild life. This is a worth-while type of enrichment as the person envolved in all probability will be an authority in his field. Listed below are three agencies that sometimes are a source of enriching community resources.

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30. C. C. Adams, "School Museums, Field Trips and Travel as phases of Objective Education", New York State Museum Bulletin 330:75-116, 1942.

Izaak Walton League of America. Local divisions may furnish speakers or give assistance on various types of projects. Many publications and films may be had either free or at nominal charge.

State Department of Conservation. This department may sometimes be able to furnish speakers. They can furnish much material either free or at moderate cost on wild life, insects and plants.

National Association of Audubon Societies. Local chapters are a definite source of phamphlets, colored slides, films and bibliographies on bird conservation and appreciation.

Resource Materials

Given below is a sampling of materials that may be had at no cost, as taken from the Educators Index of Free Materials. These phamphlets can be advantageously used in supplementing the regular textbook.

1. "Pleasure with Plants", Illinois Natural History Survey, Natural Resources Building, Urbana, Illinois. Deals with collecting and naming plants for botany students. There are similar publications on insects, mammals, mollusks and birds.
2. "Bees and Fruit", Root, A. I., Co., Medina, Ohio.
3. "How to Build up an Apiary with Combless Package Bees", Root, A. I., Co., Medina, Ohio.

   Above two are booklets on use and care of bees.

4. Circular No. 3, "Mammals and Birds of Alaska", U. S. Department of the Interior, Fish and Wildlife Service, Chicago 54, Illinois.

   This is an excellent coverage with illustrations.
5. "Basic Copper Sulphate Fungicide", Phelps Dodge Refining Corp., 40 Wall Street, New York, New York.
6. "Use of Copper Sulphate in Control of Microscopic Organisms", Phelps Dodge Refining Corp., 40 Wall Street, New York, New York.
7. "Turtox Service Leaflets", General Biological Supply House, Inc., 761-63 East 69th Place, Chicago 37, Illinois.

   These are leaflets on subjects of scientific interest. One can also be put on their mailing list for the "Turtox News".

CHAPTER VII

CHEMISTRY

One reason there is such a great need for enriching materials in chemistry is that the adopted textbook cannot keep up with current events. The chemistry book is a good guide but it is not enough. The teacher must find additional sources of material and content to enrich the course; bringing to the class the new discoveries and inventions - not waiting for these to be incorporated in the textbook. Also these new discoveries, shedding light on various subjects, might point out corrections to be made in the textbook.

These more recent discoveries and current events can be found in many sources in the community. By using one or more in connection with a certain topic under consideration, a greater interest will be displayed by the student. Listed below are some sources for new subject content:

1. Newspapers
2. Periodicals
3. State bulletins
4. United states Government pamphlets
5. Commercial literature

6. Audio-visual aids

Items from the above list very often are much more interesting to the students than the regular textbook. Other regular references that are standard in most school libraries are apt to be put in the same category as the textbook by the students. It is probable that the students who use these community resources are much more apt to become aware of the wide significance of scientific knowledge: the relation of past achievements to present and future; and the effects of scientific progress on cultural and social problems.

One of the aims of instruction in chemistry should be to provide the average person with a background which will enable him to read the chemistry in the news with some degree of understanding. Moreover, the teacher who notes the appearance of new developments in chemistry appearing in the newspapers is in a position to make his instruction more vital and meaningful.

Consumer Chemistry

One of the highlights of the author's days as a high school chemistry student was the treatment of what is now called consumer education. It was brought out that one of the better tooth powders is a mixture of common table salt and soda. The class from that day on knew more than the formulas of sodium chloride and sodium bicarbonate. About this time the volume in sales of "Crazywater Crystals" was

at its peak. It was pointed out that a nickel's worth of magnesium sulfate, commonly called epsom's salts would be the equivalent to the dollar size of the former. Also, that a very small package of boric acid would serve to make eyewashes sufficient for several years at a cost less than commercial eye preparations which are no more effective. The teaching appeared to be very casual with no attempt seemingly made to impress the student of its importance. In all probability incidental learning is as important in quality and more important in quantity. Also, much acquired mythical learning was dispelled in the chemistry class.

Consumer education should be taught in other classes but there are many phases that rightly belong in the chemistry class. Many compounds take on added interest to the student when he can identify them with daily contacts in his life outside of the school. The textbook does not adequately cover this subject. Additional source material should be taught; materials that will enrich the course and add something all the chemistry students can use - not only those going on to college. Listed below are various supplementary materials that can be used to advantage in enriching the chemistry course along the lines of consumer education.

1. Consumers' Guide

Issued monthly by the U. S. Department of Agriculture. The general type of consumer information contained within is very good and can be had free to the schools.

Write to Consumers' Counsel Division, United States Department of Agriculture, Washington, D. C.

2. Consumers' Research, Washington, New Jersey.

This is much on the same order as the Consumers' Guide. It is a monthly service which gives the results of a private testing bureau on nationally advertised products.

3. Consumers' Union, 55 Vandam Street, New York, N. Y.

This one is much the same as the first two listed but in addition there is a weekly report, "Bread and Butter", with the latest information.

4. Intermountain Consumers' Service, 1016 South Clarkson Street, Denver, Colorado.

This is a buying guide issued periodically throughout the year.

5. Federal Trade Commission Releases.

These are frequent reports of all the complaints filed by the Federal Trade Commission against producer violations and current advertising frauds. They are full of vital information which is released to all newspapers in the country but seldom printed by any. This is a free to the schools and good for the bulletin boards.

6. Notices of Judgment Under the Federal Food, Drug and Cosmetic Act.

This is a report of cases instituted in the United States District Courts under the direction of the Federal Security Administration. These proceedings should

be a part of every service reference reading table. Teachers may be placed on the mailing list for these publicationsby writing to: Federal Security Agency, Food and Drug Administration, Washington, D. C.

7. Better Buymanship Booklets, Household Finance Corporation, 919 North Michigan Avenue, Chicago, Illinois.

These booklets are free to the schools upon request of the librarian.

<u>Free Materials</u>

Listed below are several booklets that are available to teachers for the asking only. These indicate in a small way what supplementary materials are available in enriching the high school science course.

1. "A B C's of Modern Plastics" - origin, preparation and uses of plastics. Bakelite Corporation, Unit of Carbide and Carbon Corporation, 300 Madison Avenue, New York 17, New York.

2. "Coal Tar and the Chemist" - on properties and uses.

3. "Neoprene" - chemical composition and uses of synthetic rubber.

4. "Story of Cellulose" - describes the manufacture of cellulose from cotton and wood and the important chemical derivatives.

The above three can be obtained from E. I. DuPont de Nemours and Company, Inc., Wilmington 98, Delaware.

5. "Chemistry and Wheels" - combustion of gasoline in an automotive engine.

6. "Metallurgy and Wheels" - booklet on the metallurgists' part in an automobile factory.

The above two may be obtained from General Motors Corporation, Department of Public Relations, Detroit 2, Michigan.

7. "Labors of War for Peace" - peacetime application of products developed during the war.

Hercules Powder Company, Inc., Wilmington, Delaware.

8. "Industrial Catalysis" - a good description of industrial catalytic processes.

9. "A Trip Through Mellon Institute" - a description.

The above two may be obtained from Mellon Institute of Industrial Research, 4400 5th Avenue, Pittsburg 13, Pennsylvania.

10. "Chlorine" - on the difference between electron and nucleus and characteristics of each.

11. "NaOH -- Caustic Soda" - Physical and chemical properties and handling instructions.

12. "Salt of the Earth" - sources and uses of salt, caustic soda, hydrogen and chlorine.

The above three may be obtained from Pennsylvania Salt Manufacturing Company, 1000 Widener Building, Philadelphia 7, Pennsylvania.

13. "Story of Industrial Alcohol" - how it is produced

and used.

14. "U. S. I. In the World of Chemistry" - Applications of chemistry in many industries, from cosmetics to heavy equipment.

The above two may be obtained from U. S. Industrial Chemicals, Inc., 60 East 42nd Street, New York 17, New York.

Excursions

There should be a clear cut picture of just what is to be accomplished by making the excursion. This all should be brought about during the pre-trip planning. As mentioned before this planning is to be done by teacher and students with the students first deciding that the trip should be made. The greatest value can be obtained if, prior to the trip, the opportunity is taken to do all that is possible in the subject involved within the classroom. For instance, the chemistry class in Tampa, Florida might decide that a trip to the Southern Products Company was in order. There they are to see the manufacture of soap. Prior to the trip they would study the chemistry of soap and have actually made some in the laboratory.

A survey was made to find what industries were in or about Tampa, Florida to which trips could be made. The list is given below only as a guide and is indicative of the possibilities. It is not intended that special trips be made to each place but in all probability one trip could be so

arranged that it would include two or three of the places cited.

1. Florida Portland Cement Company

Mammoth machinery and equipment would be seen in addition to the manufacture of cement.

2. United States Phosphoric Products Division Tennessee Corporation.

At this plant phosphate rock as it is taken from the open pits in eastern Hillsborough County and Bartow county is processed into many commercial compounds.

3. Various citrus products plants.

Students would see processing equipment, including the evaporators for the utilization of a majority of Florida's citrus crop.

4. Tampa Paint and Varnish Company.

Here, the class would see what is envolved in the mixing of ingredients for paints and varnishes.

5. The Water Plant.

The purification by filtration and chemicals would be the highlight of this trip.

6. Southern Products Company.

The students could compare their own method and product with that of this company.

7. Analytical Chemists.

This place would be a brief stop to see a commercial laboratory in operation.

8. Tampa Gas Company

This stop would be to see how gas is manufactured and would prove to be quite interesting as well as informative.

CHAPTER VIII

PHYSICS

It has been said by some physic students "matter, matter, what does it matter?" and "physics is just plain physics". This attitude plus a dropping off of the percentage of students taking high school physics as pointed out by Johnson[31], means that if physics has a place in the high school curriculum and that place is to stay secure something must be done to make the course more attractive, interesting and worthwhile to the students. While the utilization of community resources as enriching material may not be the whole answer, it is believed that at least in part it will help.

Advantages of Resources

Nelson[32], realizing that physics could be a very difficult subject to high school students, sought to arrange the course so that it would be enjoyed by all. His philosophy was to establish a contact between the physics as used in the everyday lives of the students and its fundamental laws and

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31. Philip G. Johnson, "Planning Your High School Physics Courses", School Science and Mathematics, 49:204-216, March 1949.
32. O. C. Nelson, "Teaching Physics As We Use It", School Science and Mathematics, 47:829-835, December, 1947.

principles. His use of community resources had the following advantages when used in preference to the traditional methods.

1. The resource is substituted for the abstract as the center of interest.
2. The student has more real interest if he already knows something about the subject under consideration.
3. The learning seems purposeful.
4. Parents like it, because their children are studying something they are interested in also.
5. Consumer education is constantly taking place.
6. A higher percentage of students taking physics from year to year.

Experiments performed by the students in the laboratory are apt to be very cold, dry, and boresome. Especially, if a laboratory manual is used, the process may merely consist of filling in blanks, with no real thinking taking place. To avoid this, care should be taken in choosing the experiments. If and when possible the experiment should suggest itself to the student. The ideas for experiment might come from the textbook or from the home and community. A good example was the question one boy put to the teacher about the effect of cooking with a lid on the pot. The teacher may have answered the question quite simply but before the week was over the boy and his partner had several cooking vessels in the laboratory including a pressure cooker. By taking temperatures along with cooking a potato much was found

out by the boys and from that day on they always looked for the reason in doing an experiment and almost always found out why.

Much equipment not in the laboratory can be improvised. One question usually asked in studying friction is about how rain affects the coefficient of friction - between the rubber tire of an automobile and concrete; also the difference between concrete and "black top". Let members of the class get or make pieces of concrete and "black top". Pieces of tire, both with tread and smooth, will complete the makeshift apparatus if equal weights are available to put in the pieces of tire. The experiment in friction now takes on more meaning and the students are ready to find out all they can.

Mechanical advantage when studied in the laboratory seemed more practical when various types of automobile jacks and block and tackle sets were used. The student who brought a jack or piece of equipment had a personal interest in the problem.

The atom bomb is on the minds of most high school students. They are wondering about atomic energy and radioactivity and often ask embarrassing questions concerning this subject. Nothing is to be found in the textbook and the students should not be put off. They are interested in the subject; it is vital to them, so they are ready for at least a brief presentation on nuclear

physics. Student aid should be enlisted in searching for material. Various magazines have had articles dealing with the atomic bomb including many issues of Life, Fortune, Popular Science and Science News Letter. At least one corporation has put out a pamphlet on atomic energy and that is a 32 page illustrated, "Little Science Series" booklet, "The World Within the Atom"[33]. This booklet, prepared by Dr. L. W. Chubb, Director Emeritus of the Westinghouse Research Laboratories, tells how scientists explored the atom and learned to release its energy. It describes the work of Thomson, Rutherford, Bohr and Curie, and other scientists, and gives important background information on nuclear physics and on the development of the atomic bomb.

Free Materials

Given below are some of the items listed in the Educators' Index of Free Materials which are excellent to supplement the textbook.

1. "Behind the Switch" - on the general transmission and distribution of electricity.

   Alabama Power Company, Birmingham 2, Alabama.

2. "Edison Storage Batteries" - how batteries are made and used.

   Thomas A. Edison, Inc., Storage Battery Division, West Orange, New York.

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33. Copies of the booklet for classroom distribution can be obtained, free, from School Service Dept. Westinghouse Electric Corp. 306 Fourth Ave. Box 1017, Pittsburg 30, Pennsylvania

3. "The Storage Battery" - its fundamental, use and care.

Electric Storage Battery Company, Allegheny Ave. and 19th Street, Philadelphia 32, Pennsylvania.

4. "The Miracle of Ice from Heat" - gas refrigeration explained so everybody can understand it; a technical description follows the popular explaination.

Servel Inc., Evansville 20, Indiana.

5. L. C. 449 "Standards of Length, Mass, and Time".

6. L. C. 600 "Timekeeping Through the Ages".

7. L. C. 681 "Units and Systems of Weights and Measures".

These above three may be obtained from United States Department of Commerce, National Bureau of Standards, Washington, 25, D. C.

8. "Highways of Wire" - thirty page booklet by A. C. Monteith. In this booklet Monteith discusses the basic component parts of a typical power plant, traces the path of electric current from the generating plant to the consumer.

Westinghouse Electric Corp., 306 Fourth Avenue, Box 1017, Pittsburg 30, Pennsylvania.

CHAPTER IX

SUMMARY AND CONCLUSIONS

The teacher is the key person responsible for a child's learning. Many others in the long educational chain of command have their say about the curriculum as a whole and even may decide the exact content to be given within a specific course. Some teachers may at times be able to voice an opinion about textbooks, but on the whole, the teacher has not any individual say about the classroom situation until he is face to face with the class. It is now up to the teacher if the ideal learning situation is to be approached. The pupils must be motivated and this cannot be done by the superintendent or school board.

The teacher must always be alert to find materials for course enrichment. To enrich a subject is to promote a better learning situation. As has been pointed out, there was a time when the major objective of high school was preparation for college. This objective has not been abandoned but others have been added, including personal, vocational, and civic aims. Since these added objectives have been included under the philosophy of public education and in view of the desirability of taking into account the different capacities of individual students the time is past when the textbook

is the sole source of course content. Since the text is inadequate, additional materials must be found. The sources are many for supplementary materials, but the alert teacher will look close about him for those community resources that will aid instruction. The aid will be in the form of enriched teaching, more meaningful and understandable concepts for the students and a greater interest of the students in the subject. As the textbook is supplemented with community resources the course will quickly detach itself from the formal variety of education to become an enriched curriculum that is considerably more functional.

There is much less chance for the curriculum or the individual subjects to become stagnant and separated from reality. Many changes will be automatic. New inventions, discoveries, and thought will be incorporated in the community resources being used. The teacher will not wait for changes to take place in the infrequent editions of textbooks.

Community resources to be used as enriching materials and devices are divided into excursions and those materials or people that can be used in the regular classroom. The materials used within the classroom are much more important than the excursion.

There are two distinct types of trips. The longer type, those lasting more than one day, is the exception and is not widely used. Its practical significance is limited

The shorter excursion or field trip is a much more valuable technique. These trips are completed within one school day and generally last only a few hours. Frequently, as in the case of biology field trips they have a duration of only the classroom period itself. First hand experience is more valuable than the vicarious. These trips given the student gives him the opportunity of seeing things in their natural setting, fascilitating the understanding of larger concepts and provide a positive interest which is the best kind of motivation.

As in almost everything else there are difficulties associated with field trips. Even though the students take part in the planning, considerable time must be spent by the teacher in preparation. Also there is the problem of who can take over the teacher's other classes while he is away. At the larger schools the teacher may take several of his classes at one time. In other cases, when other classes will be left without his services definite arrangements will have to be made. The teacher across the hall may be able to take care of this class as well as his own. Better than this, the principal can take over the absent teacher's place. This has happened many times and could be good for the children and it would give the non-teaching principal an opportunity to keep in closer contact with the pupils and actual teaching.

These difficulties are enough to curtail the actual number of trips to be taken by the science classes. In fact,

two or three a year might be all that could be worked into the schedule, but these would be very worth-while. The biology classes in rural or near rural section could probably make more but shorter trips into the field nearby. These excursions are an old technique but are still very profitable, if they are economical of time and energy. They break the routine of day to day instruction.

The main value in using community resources comes in those which are brought into the classroom. The majority of these materials are free or can be had at only a small cost. If they were the least bit expensive, their actual potentialities would be greatly curtailed. The community resource materials are easily obtainable and the extra teacher planning involved is nil. They supplement, illustrate, vivify and increase interest in instruction in the classroom.

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